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ABSTRACT

Analyses of the deployment of technology in schools usually note its lack of impact on the day-to-day values and practices of teachers, administrators, and students. This is generally construed as an implementation failure, or as resulting from a temperamental shortcoming on the part of teachers or technologists. It is predicated on the tacit assumption that the technology itself is value-free. This paper proposes that technology is never neutral: that its values and practices must always either support or subvert those of the organization into which it is placed; and that the failures of technology to alter the look-and-feel of schools more generally results from a mismatch between the values of school organization and those embedded within the contested technology. The paper is organized in five major sections addressing: (1) the culture of schools; (2) school workers; (3) the culture of technology; (4) the culture of refusal; and (5) cultural change. (Contains 31 references.) (Author/TMK)

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ED 366 328

TECHNOLOGY REFUSAL AND THE ORGANIZATIONAL CULTURE OF SCHOOLS, V.1.4

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ABSTRACT:

Analyses of the deployment of technology in schools usually note its lack of impact on the day–to–day values and practices of teachers, administrators, and students. This is generally construed as an implementation failure, or as resulting from a temperamental shortcoming on the part of teachers or technologists. It is predicated on the tacit assumption that the technology itself is value–free. This paper proposes that technology is never neutral: that its values and practices must always either support or subvert those of the organization into which it is placed; and that the failures of technology to alter the look–and–feel of schools more generally results from a mismatch between the values of school organization and those embedded within the contested technology.

THE CULTURE OF SCHOOLS

For nearly a century outsiders have been trying to introduce technologies into high school classrooms, with remarkably consistent results. After proclaiming the potential of the new tools to rescue the classroom from the dark ages and usher in an age of efficiency and enlightenment, technologists find to their dismay that teachers can often be persuaded to use the new tools only slightly, if at all. They find further that, even when the tools are used, classroom practice—the look–and–feel of schools—remains fundamentally unchanged. Indeed, the last technologies to have had a lasting impact on the organization and practice of schooling were the textbook and the blackboard.

What is often overlooked, however, is that schools themselves are a technology, a way of knowing applied to a specific goal, albeit one so familiar that it has become transparent. They are systems for preserving and transmitting information and authority, for inculcating certain values and practices while minimizing or eliminating others, and have evolved over the past one hundred years or so to perform this function more efficiently (Tyack, 1974). Since schools do not deal in the transmission of all possible knowledge or the promotion of the entire range of human experience but only a fairly stable subset thereof, and since their form has remained essentially unchanged over this time, we can even say that schools have been optimized for the job we entrust to them, that over time the technology of schooling has been tuned. When schools are called upon to perform more "efficiently," to maximize outputs of whatever type (high school or college graduates, skilled workers, patriotic citizens, public support for education and educators) from a given set of inputs (money, students,

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staff, legal mandates, public confidence), it is their capacity to act as technologies, as rational institutions, that is being called upon. It is expected that, after analyzing the facts at hand and determining that a problem exists (high drop–out rates or functional illiteracy, for instance) and within the limits of their discretion (since they are not free to act however they wish), schools will attempt to implement an optimal solution, the one that yields the most bang for the buck. This expectation, too, derives from the assumption that schools, since they are purpose–built machines, will pursue the rational, deductive means–ends approach that characterizes rational pursuits. Following this, it is also expected that schools will embrace, indeed will clamor for, any technology that would help them increase their productivity, to perform more efficiently and effectively. It seems natural that they should employ the same tools that have led the world outside the classroom to become a much more information–dense environment, tools like film, television, and computers. Certainly many educational technologists reflexively expect such a response, and are both miffed and baffled when it is not immediately or abundantly forthcoming.

But schools are not *simply* technologies, nor are they purely or even mainly rational in the ways in which they respond to a given set of conditions. They also have other purposes, other identities, seek other outputs. They are, perhaps first and foremost, organizations, and as such seek nothing so much as their own perpetuity. Entrenched or mature organizations (like the organisms to which they are functionally and etymologically related) experience change or the challenge to change most significantly as a disruption, an intrusion, as a failure of organismic defenses. This is true ten–fold for public schools since they and their employees are exempt from nearly every form of outside pressure which can be brought to bear on organizations that must adapt or die (Chubb & Moe, 1990; Friedman, 1962).

Organizations are not rational actors: their goal is not to solve a defined problem but to relieve the stress on the organization caused by pressure operating outside of or overwhelming the capacity of normal channels. Their method is not a systematic evaluation of means and ends to produce an optimum response, but rather a trial–and–error rummaging through Standard Operating Procedures to secure a satisficing response. As organizational entities, schools and the people who work in them must be less than impressed by the technologists' promises of greater efficiency or optimized outcomes. The implied criticism contained in those promises and the disruption of routine their implementations foreshadow, even (or especially) for the most dramatic of innovations, are enough to consign them to the equipment closet. What appears to outsiders as a straightforward improvement can, to an organization, be felt as undesirably disruptive if it means that the culture must change its values and habits in order to implement it. Since change is its own downside, organization workers must always consider, even if unconsciously, the magnitude of the disruption an innovation will engender when evaluating its net benefit and overall desirability. This circumspection puts schools directly at odds with the rational premises of technologists for whom the maximization of organizational culture and values almost always takes a back seat to the implementation of an 'optimal' response to a set of conditions defined as problematic. Indeed, a characteristic if unspoken assumption of technologists and of the rational model in general is that cultures are infinitely malleable and accommodating to change. As we'll see later, schools' natural resistance to organizational change plays an important (though not necessarily determining) role in shaping their response to technological innovation.

Organizations are defined by their lines of flow of power, information, and authority. Schools as workplaces are hierarchical in the extreme, with a pyramidal structure of power, privilege, and access to information. (Indeed, proponents of the "hidden curriculum" theory of schooling propose that acceptance of hierarchy is one of the main object lessons schools are supposed to impart.) At the bottom, in terms of pay, prestige, and formal autonomy are teachers. Next up are building–level administrators, and finally, district–level administrators. Although students have even less power than teachers, and state–level actors more power than district administrators, neither of these groups is considered a part of school organizational culture (Fullan, 1991). Any practice (and a technology is, after all, a set of practices glued together by values) that threatens to disrupt this existing structure will meet tremendous resistance at both adoption and implementation stages. A technology that reinforces existing lines of power and information is likely to be adopted (a management decision) but may or may not be implemented (a classroom–level decision). The divergence of interests between managers and workers, and the potential implementation fissures along those lines, is a source of much of the implementation failure of widely–touted "advances."

Finally, in addition to their rational and organizational elements, schools are also profoundly normative institutions. Most obviously, schools are often both actors and venues for the performance of significant shifts in social mores and policy. Within the lifetime of many Americans, for example, schools have institutionalized successive notions of separate–and–unequal, separate–but–equal, equal resources for all, and, most recently, unequal resources for unequal needs as reifications of our shifting cultural conceptions of "fairness." Because schools are the ubiquitous intersection between the public and the private spheres of life, feelings about what "values" should and should not be represented in the curriculum run deep and strong among Americans, even those without school–age children. When thinking about values, however, it is crucial to remember that schools generally do not seek this contentious role for themselves. More often than not it is imposed upon them by legislators, the courts, community activists, and others whose agenda, though it may to some degree overlap with that of the schools', has a different origin and a different end (See Note 1). For if anything, the norms of school culture are profoundly conservative, in the sense that the underlying mission of schools is the conservation and transmission of preexisting, predefined categories of knowledge and being. As David Cohen points out, the structure of schools and the nature of teaching have remained substantially unchanged for seven hundred years, and there exists in the popular mind a definite, conservative conception of what schools should be like, a template from which schools stray only at their peril (Cohen, 1987).

When parents or others speak with disapproval of the "values" that are or are not being transmitted to children in schools they largely miss the point. For the values that predominate most of all, that indeed must always predominate, are less the set of moral and social precepts which the critics have in mind than the institutional and organizational values on which the school itself is founded: respect for hierarchy, competitive individualization, a receptivity to being ranked and judged, and the division of the world of knowledge into discreet units and categories susceptible to mastery (Dreeben, 1968). To a very great extent these values are shared in common with our other large–scale institutions, business and government. Indeed, if they were not, it seems most unlikely that they would predominate in schools. They are, in fact, the core values of the bourgeois humanism that has been develop-

ing in the West since the Enlightenment, and it is these norms and values, more than the shifting and era–bound constructions of social good, that schools enact in their normative capacity. There is a tight coupling between these values and schools–as–a–technology, just as there is between any technology and the values it operationalizes. Given this linkage it's often difficult to say with certainty whether school values predate the technology of schools–as–we–know–them, in which case the technology is a dependent tool dedicated to the service of an external mandate, or whether the technology produces, *sui generis*, a set of values of its own which are then propagated through society by school graduates. When it is this difficult to extract a technology from its context, you know you have found a tool that does its job very, very well.

SCHOOL WORKERS

In manifesting its culture, school places teachers and administrators in an unusual and contradictory position. They are subjected to many of the limitations of highly bureaucratic organizations but are denied the support and incentive structures with which bureaucracies usually offset such constraints. School workers are the objects of recurring scrutiny from interested and influential parties outside of what is generally conceived of as the "school system," many of whom have conflicting (and often inchoate) expectations for what schools should accomplish. Their means, ends, and abilities are regularly called into question by parents, politicians, social scientists, the business community, and any group with an ideological axe to grind, not least by those who consider themselves to be allies of schools. Yet teachers and administrators almost always lack the rights of self–definition and discretionary control of resources (time, money, curriculum) that generally accompany this kind of accountability to give it form and meaning. Despite their strident protests school workers are treated more as day laborers than as professionals.

At the same time, even the most complacent bureaucracies direct some incentives at their workers. These may be monetary, in the form of performance bonuses or stock options, career enhancing in the form of promotions, or sanctions like demotion and the consequent loss of authority and responsibility. Schools generally offer none of these. Instead they proffer to good and bad alike a level of job security that would be the envy of a Japanese sarariman: unless you commit a felony or espouse views unpopular in your community you are essentially guaranteed employment for as long as you like, no matter what the quality of your work. Teachers cannot be demoted: there is no position of lesser authority or responsibility within schools.

Just as students are essentially rewarded with promotion for filling seats and not causing trouble, so teachers are paid and promoted on the basis of seniority and credentials rather than performance. Providing they have not violated some school norm, it is not uncommon for teachers or administrators who demonstrate incompetence or worse at their assigned tasks to be transferred, even promoted, to off–line positions of higher authority rather than being fired, demoted, or re–trained. Perversely, the only path to formally recognized increase in status for dedicated, talented teachers is to stop teaching, to change jobs and become administrators. Some schools and states are starting to create Master Teacher designations and other forms of status enhancement to address the need for formal recognition of excellence, but the

overwhelmingly dominant practice provides no such acknowledgement for outstanding practitioners, thus lumping all teachers together into an undifferentiated mass. This pervasive deskilling of and condescension towards the teachers' craft is central to the organizational culture of schools, and teachers' reaction against it forms the base of their suspicions of the motives and values of technologists who claim to be able to improve education by substituting the output of a teacher with that of a box.

As with any organization possessed of a distinct and pervasive culture, schools attract and retain either those most comfortable with their premises and conditions, those without other options, or those who care deeply about the organizational mission and are willing to accept the personal disadvantages that may accompany a "calling." Most beginning teachers identify with the latter group, and approach their nascent careers with excitement and commitment. Indeed, they are prepared to work for not much money under difficult conditions in order to pursue this commitment. It's in the nature of people and organizations, however, for workaday values and practices to replace idealism as the defining experience of place and purpose. This means that over the long term the idealism and enthusiasm of the novice teacher must necessarily give way to the veteran's acquiescence to routine. It is this willingness to accept the values of the organizational culture and not the nature of the personal rewards that determines who remains in teaching and who fails or leaves.

In plumbing the nature of a bureaucratic organization, we must take into account the personalities and skill sets of those who seek to join it. According to studies cited by Howley et al, prospective teachers have lower test scores than do prospective nurses, biologists, chemists, aeronautical engineers, sociologists, political scientists, and public administrators (Howley, Pendarvis, & Howley, 1993). They also cite studies which demonstrate a negative correlation between intellectual aptitude and the length of a teacher's career. Recognizing that there are many reasons to dispute a correlation between standardized test scores with intellectual capacity, depth, or flexibility, Howley cites Galambos et al to demonstrate that

> "teachers, as compared to arts and sciences graduates, take fewer hours in mathematics, English, physics, chemistry, economics, history, political sciences, sociology, other social sciences, foreign languages, philosophy, and other humanities." (Galambos, Cornett, & Spitler, 1985)

She reports other studies which show that teachers read no more, and probably less, than the average middle class person (approximately three to eight books per year) and that their reading tends overwhelmingly to be popular material rather than scholarly or scientific work (Duffey, 1973, 1974; Vieth, 1981). The fact that teachers are not, as a group, accomplished or engaged intellectuals does not require that they be resistant to change. It does suggest, though, a certain comfort with stasis and a reluctance to expand both the intellectual horizon and the skill set necessary to achieve proficiency with new technologies. This may help to explain the unusually long latency required to master personal computers that has been reported to Kerr and Sheingold by teachers who have incorporated technological innovations into their practice (Kerr, 1991; Sheingold, 1990).

Given that long–term school workers are well adapted to a particular ecosocial niche it is understandable that their first response to attempts at innovation would be one of resistance. Calls for change of any kind are seen as impositions or disturbances to be quelled as soon as possible, as unreasonable attempts to change the rules in the middle of the game. Larry Cu-

ban has described the position of teachers as one of "situationally constrained choice," in which the ability to pursue options actively desired is limited by the environment in which teachers work (Cuban, 1986). While this is true as far as it goes, I prefer to see the process as one of gradual adaptation and acquiescence to the values and processes of the organization, rather than the continued resistance and frustration implied by Cuban; in other words, as one of situationally induced adaptation. This, I think, more easily explains the affect and frame of mind of most veteran teachers and administrators, and accommodates the likelihood that the average teacher is no more heroic or enduring than the average office worker.

THE CULTURE OF TECHNOLOGY

If the State religion of America is Progress, then surely technology provides its icons. It is largely through the production of ever–more marvelous machines that we redeem the promise of a better tomorrow, confirm the world's perfectibility, and resorb some to ourselves and to our institutions. As Cohen succinctly puts it,

> "...Americans have celebrated technology as a powerful force for change nearly everywhere in social life...[and] are fond of picturing technology as a liberating force: cleaning up the workplace, easing workers' burdens, making the good life broadly available, increasing disposable income, and the like." (Cohen,1987, p. 154)

But it goes further than that. Our machines not only signal and refresh our modernity, they serve as foundational metaphors for many of our institutions, schools among them (See Note 2). Machines corporealize our rationality, demonstrate our mastery. They always have a purpose and they are always *prima facie* suited to the task for which they were designed. Every machine is an ideal type, and even the merest of them, immune to the thousand natural shocks the flesh (and its institutions) is heir to, occupies a pinnacle of fitness and manifests a clarity of purpose of which our institutions can only dream. They reflect well on us, and we measure ourselves by their number and complexity. It is nearly inconceivable that we would imagine a school to be complete, no, to be American, that was without a representative sample of these icons of affirmation. It is absolutely inconceivable that we would trust our children, our posterity, to anything less than a machine, and so we relentlessly build, and generally fill, our schools.

For although they often seem so ageless and resilient as to be almost Sphinx–like in their inscrutability, schools as we know them are both relatively recent and consciously modeled on that most productive of all technologies, the factory (Tyack, 1974). For at least the last hundred years, schools have been elaborated as machines set up to convert raw materials (new students) into finished products (graduates, citizens, workers) through the application of certain processes (pedagogy, discipline, curricular materials, gym). It is this processing function that drives the rationalist proposition that schools can be tuned well or poorly, can be made more or less efficient in their operation. Although it seldom articulates them overtly, this view is predicated on the assumptions that we know what we want schools to do, that what we want is unitary and can be measured, and that it can be affected by regular, replicable modifications to one or more school processes. It presumes that the limits of education are essentially technological limits and that better technology will remove them. It is the most generic and encompassing theory of "educational technology," since it embraces all cur-

ricular, instructional, and material aspects of the school experience. In its more comprehensive and embracing instantiations such an attitude does not limit its concerns only to the school plant. For early progressive educators (and again today) students' readiness–to–learn, in the form of adequate nutrition, housing, and medical care, was seen as a proper concern for school "technologists."

So far we can detect at least two impetuses for wanting to bring machines into schools. The first is the desire of the central planner and social scientist to have these social crucibles be as modern as the world of tomorrow they help conjure into being. Cuban details how each new development in the popularization of information and entertainment technology (radio, film, television, computers) in society at large brought with it a corresponding insistence that the deployment of this revolutionary machine into schools would, finally, bring the classroom out of the dark ages and into the modern world (Cuban, 1986). Attempts to deploy technology that follow this pattern seldom specify how the machines will be used, and if outcomes are discussed at all it is in vague, incantatory language that employs words more as talismans than as descriptors. The connection between such scenarios and the outcomes they believe they strive for is essentially semio–magical, using up–to–date machinery to signify modernity and believing that the transformative power resides in the box itself rather than in the uses to which it is put. Given their non–rational character, it's not surprising that these initiatives originate with elected officials, school administrators, community groups (business, parents) and others for whom the signalling function is important. They tend not to originate with technologists or classroom teachers, who have very different (if very differing) agendae.

By "technologists" I mean those whose avowed goal is to make schooling more efficient through the manipulation of its objects or processes. "Efficiency," however, is not the straightforward, value–free quantity that those who most embrace it suppose it to be. An industrial–revolution coinage, the concept of efficiency was intended to denote the relative quantity of useless energy consumed during manufacturing or processing, contexts in which such things can be easily and unambiguously measured. Clearly, the socially–situated diffusion of skills and values that is our system of education presents a very different case, one that is more complex, more contested, more informed by subjectivity. In order to apply the concept of efficiency to such a messy world technologists and others must narrow their gaze to focus on one particular element of the process. (Under "others" I include economists, those technologists–without–machines, whose persistent attempts to discover and apply a production function to education in the face of piles of their own unambiguous evidence, ranks with the alchemists' persevering search for the philosopher's stone as one of rationality's great cul de sacs.) Technologists have therefore tended to focus on the transfer of information to students, partly because it is one of the few processes in schools that can be measured, and partly because it is one of the few functions that everyone agrees schools should perform. What they discovered almost immediately was that when judged simply as knowledge–transfer machines schools are just not very good. It seems to take an awful lot of workers, money, and other resources to transfer a relatively small amount of information. By framing the question in this way, technologists (re)cast education as a fundamentally didactic process, and problems with education as problems of "instructional delivery." This didacticism posits education as the transfer of information from a repository to a receptacle, a cognitive diffu-

sion gradient across a membrane constituted not by the rich, tumultuous, contradictory social processes that situate the student, the teacher, and the school within society, but solely by the "instructional delivery vehicle." By this light, of course, nearly any organic, indigenous school practice or organization will be found wanting, since schools intend to promote many outcomes ahead of information transfer.

The second concern of technologists has been standardization. Schools are supposed to produce the same outputs year after year. They are supposed to ensure that seventh graders, say, will emerge at essentially the same age with essentially the same sets of skills and broad values this year as last. If they do not then important categories like "seventh grade" or even "common school" lose their meaning. Signalling functions aside, the explicit reason given for modelling schools on factories was their promise of standardization, of uniformity of outcome. Technologists and planners have long realized that the weakest link in this chain is the last, "the instructional delivery vehicle," the teacher. Standardization of curricula, of facilities, of teacher certification requirements, means little once the classroom door is closed and the teacher is alone with her students. The inefficiency and variability of this last crucial stage undoes all prior ratiocination. For this reason, educational technologists have tended to produce solutions designed not to aid the teacher, but to recast, recapitulate, or replace her, either with machines or through the introduction of "teacher–proof" curricula (See Note 3).

Yet all these attempts to modernize, to rationalize, to "improve" the schools by making them more efficient have had very little effect. Textbooks, paperbacks, blackboards, radio, film, film strips, airplanes, television, satellite systems and telecommunications have all in their time been hailed as modernizers of American education (Cuban, 1986). Cohen, for his part, demonstrates how, with the exception of the textbook and the blackboard, none of these much–vaunted exemplars of modern efficiency have had any significant effect on school organization or practice (Cohen, 1987). They have not made schools more modern, more efficient, more congruent with the world outside the school, or had any of the myriad other effects their advocates were sure they would have. Why is this so?

THE CULTURE OF REFUSAL

Technology can potentially work change on both the organizational and practice patterns of schools. That change can subvert or reinforce existing lines of power and information, and this change can be, for the technologist or the school personnel, intentional, inadvertent or a combination of the two. Since schools are not monolithic but composed of groups with diverse and generally competing interests on the rational, organizational, and symbolic levels, adoption and implementation of a proposed technology are two very different matters.

And yet each battle is essentially the same battle. The technologists' rhetoric is remarkably consistent regardless of the specifics of the machine at issue. So too is their response when the technologies in question meet with only a lukewarm response: to blame the stubborn backwardness of teachers or the inflexibility and insularity of school culture. While elements of both of these certainly play their part in what I'll call 'technology refusal' on the part of schools, it behooves us to remember that all technologies have values and practices embedded within them. In this respect, at least, technology is never neutral; it always makes

a difference. From this perspective, the reactionary response on the part of schools (by which I mean the response of individuals within schools acting to support their institutional function) perceived by technology advocates makes a great deal more sense than the pig–headed Luddism so often portrayed. Further, technology refusal represents an immediate and, I believe, fundamentally accurate assessment of the challenges to existing structures and authority that are embodied or embedded in the contested technology. I believe further that the depth of the resistance is generally and in broad strokes proportionate to the seriousness of the actual threat.

Change advocates, of whom technologists are a permanent subset, often try to have things both ways. On the one hand, the revolutionary potential of the innovation is emphasized, while at the same time current practitioners are reassured (implicitly or explicitly) that their roles, positions, and relationships will remain by and large as they were before. The introduction of computers, for example, is hailed in one discourse (directed towards the public and towards policy makers) as a process which will radically change the nature of what goes on in the classroom, give students entirely new sets of skills, and permanently shift the terrain of learning and schools. In other discourse (directed towards administrators and teachers) computers are sold as straightforward tools to assist them in carrying out preexisting tasks and fulfilling preexisting roles, not as Trojan Horses whose acceptance will ultimately require the acquisition of an entirely new set of skills and world outlook. Since school workers and their practice do not (indeed, cannot) fully maximize instructional delivery, the "remedies" or alternatives proposed by technologists necessarily embody overt or implicit critiques of workers' world view as well as their practices. The more innovative the approach the greater its critique, and hence its threat to existing principles and order. When confronted with this challenge, workers have two responses from which to choose. They can ignore or subvert implementation of the change or they can coopt or repurpose it to support their existing practices. In contrast to generalized reform efforts, which Sarason maintains are more likely to be implemented the more radical they are, these efforts by technologists to change the institution of schooling from the classroom up make teachers the objects rather than the subjects of the reformist gaze (Sarason, 1990). The more potent and pointed technologists' ill–concealed disinterest in or disregard for the school–order of things, the less likely their suggestion are to be put into practice. The stated anxiety of teachers worried about losing their jobs to machines is also a resistance to the re–visioning of the values and purposes of schooling itself, a struggle over the soul of school. It is about self–interest, to be sure, but it is also about self–definition.

Much of the question of teacher self–definition revolves around the anxiety generated by their unfamiliarity and incompetence with the new machines. The fear of being embarrassed is a major de–motivating factor in the acquisition of the skills required to use computer technology in the classroom (Honey & Moeller, 1990; Kerr, 1991; Sheingold & Hadley, 1990). This is an area where institutional and individual interests converge to produce a foregone effect. The (self–) selection for teaching of individuals who by and large show neither interest nor aptitude for ongoing intellectual development buttressed by the condition of lifetime employment almost guarantees a teacher corps that is extremely reluctant to attempt change. This, in turn, suits the interests of school management whose job is made considerably simpler with a population of workers whose complacence acts as a buffer against change. Since

teachers' situationally–reinforced lack of motivation inhibits their action as change agents, school administrators are relieved of the responsibility for developing the creative management skills that would be required for teachers to develop new classroom skills.

There are technologies which are suited perfectly to such a climate; those that either actively support the organization of schools or are flexible enough to readily conform to it (Cohen, 1987). Not surprisingly, they are the ones that are so ubiquitous, so integrated into school practice as to be almost invisible. On the classroom level we would expect to find tools and processes that both ease the physical labor of the teacher while maintaining her traditional role within the classroom. The blackboard, the duplicating machine, and the overhead projector come immediately to mind. All enhance the teacher's authoritative position as information source, and reduce the physical effort required to communicate written information so that more energy can be devoted to the non–didactic tasks of supervision, arbitration, and administration. This type of technology seldom poses a threat to any of the teacher's functions, is fundamentally supportive of the school–values mentioned earlier, and reproduces locally the same types of power and information relationships through which the teacher herself engages her administrators. We might also consider the school intercom system. Ideally suited to the purposes of centralized authority and the one–way flow of information, it is as ubiquitous in classrooms as its polar opposite, the direct–dial telephone, is rare. Technologies such as these will seldom meet with implementation resistance from teachers because they support them in the roles through which teachers define themselves, and contain no critique of teachers' practice, skills, or values. In general, resources that can be administered, that can be made subject to central control and organization, will find more favor from both administrators and teachers than those that cannot.

These examples of successful technologies confirm the requirement of simplicity if a technology is to become widely dispersed through classrooms. This has partly to do with the levels of general teacher aptitude described above, partly with the amount of time available to teachers to learn new tools, and partly with the very real need for teachers to appear competent. As with prison administration and dog training, a constant concern in the running of schools is that the subject population not be reminded what little genuine authority supports the power its masters exercise. Although there are more complex models for understanding the diffuse polysemous generation of power and status that comprise the warp and woof of institutional fabric (see Foucault on medicine or prisons, for example), for our purposes here a simple model of authority–as–imposition will suffice. In this tradition, French and Raven describe the five sources of power as follows:

> 1. Reward, the power to give or withhold something the other wants;
>
> 2. Coercive, the power to inflict some kind of punishment;
>
> 3. Legitimate, the use of institutionally–sanctioned position or authority;
>
> 4. Referent, the use of personal attraction, the desire to be like the other, or to be identified with what the other is identified with;
>
> 5. Expert, the authority that derives from superior skill or competence.
>
> (French & Raven, 1968).

Short of insurrection, the only form of power accessible to students is Expert power. Thus, an unfortunate (but hardly unforeseeable) consequence of school organization is that

teachers for whom authority is important must prevent their students from acquiring or demonstrating mastery of a degree or a domain that would reflect unfavorably on the teacher. Although some teachers handle it with more grace and maturity than others, most dread the occasions when they are "shown up" by their students, and we have all witnessed or experienced those awkward, lingering out–of–time moments when the teacher must voluntarily cede authority to the student who knows how to thread the projector or connect the vcr. At such times the brittle consensual veneer of adult expertise is cracked, the order of things briefly disrupted (confirmed by the sudden eruption of murmuring in the classroom), and casual but alert attention directed by teacher and students alike toward the performance of the evanescent student expert.

It is one thing for students to demonstrate expertise in areas that are not expected to be a formal part of teachers' skill set, like threading 16mm projectors. If technologists have their way, however, teachers will be expected to know how to use computers, networks, and databases with the same facility they now use blackboards and textbooks, and with greater facility than the roomful of resourceful, inquisitive students who were weaned on the stuff. The pressure towards competence and the acquisition of new skills, which is generally not a feature of school culture or the employment contracts under which teachers work, will be strong. It will come from unexpected directions: from below (from the "tools" themselves) and from within, as teachers struggle to retain mastery over their students. It's easy to see why teachers would resist this scenario. Administrators, for their part, have equally few organizational incentives for inviting this disruption into schools. Not only would they be required to respond to teachers' demands for the time and resources needed to attain proficiency, they themselves would need to attain some minimum level of competence in order to retain authority over teachers. Since there is no way for the system to reward this kind of involved, responsible management, nor any way to penalize its absence, school authorities' most sensible route is to ignore or quell demands for the implementation of such potentially disruptive processes.

The machines of the day are microcomputers and microcomputer networks. Having inherited the mantle of modernity from instructional television and computer–aided instruction, they are presently charged with the transformation of schools. As school technologies, however, they are unusually polyvalent: they can both support and subvert the symbolic, organizational, and normative dimensions of school practice. They can weaken or strengthen the fields of power and information which emanate from the institutional positions of students, teachers, and administrators. It's my thesis that authority and status within organizations are constituted from two sources: power, itself sourced as outlined by French and Raven, and control over and access to the form and flow of information. Authority and status are singularities, as it were, produced by a particular confluence of (potentially) shifting fields of power and information. This is true in the organizational sense for all bureaucracies, where the person who knows something is as important as the person who can do something. In schools, though, facility with information is (in a slightly different sense) at the heart of key norms, values, and practices as well. As bureaucratic, hierarchical institutions and as concretizations of a particular tradition of pedagogy, schools teach and model as canonical a particular arrangement of paths for the flow of information. Introducing computers

into schools highlights these assumptions, causes these normally invisible assumptions and channels to fluoresce.

It is not their capacity to process information that gives computers this special ability. Data processing systems have existed in large school districts for decades, helping central administration to run their organizations more efficiently. Irregularities of control call attention to themselves and thereby remind workers that such arrangements are created things, neither aboriginal nor ahistorical but purpose–built and recent. To the extent that automation can help existing administrative processes to run more smoothly and recede into the background, they help to reintroduce a kind of medieval reassurance regarding the rightness and permanence of a given order. Schools and school workers, particularly, seem to prefer this type of predictability. Such data processing regimes also relieve school workers of much of the tedium of their administrative work: scheduling, grading, communication, and tracking are all made less drudging by automation. The easing of these burdens offered by the machine fits very well with popular conceptions of these labor–saving devices and offers workers a benefit in exchange for their participation in a process which strengthens the mechanisms of control exerted by the bureaucracy over their daily lives and practice. To the extent that they are aware of this bargain at all most are willing to accept it.

This strengthening of administrative priority and control over teachers is recapitulated by teachers over students when computers are used for cai or as "integrated learning systems." Although they have fallen out of favor somewhat of late, the vast majority of school–based computer use has taken place in this context. Kids are brought en masse to a (generally) windowless room presided over by a man with no other function than to administer the machines. There they work for between 30 and 50 minutes on drill–and–practice software that compels them to perform simple tasks over and over until they have reached a preset level of proficiency, at which time they are started on new tasks.

This behaviorist fantasy fits neatly into the organizational model of schools, and into much pedagogical practice as well. The progress and work habits of each student are carefully tracked by the server. Reports can be generated detailing the number of right and wrong answers, the amount of time spent on each question, the amount of "idle" time spent between questions, the number of times the student asked the system for help, the tools she used, etc. Not much use is ever made of this information (assuming some could be) except to compare students and classes against one another. Nevertheless, the ability to monitor work habits, to break tasks down into discrete chunks, and the inability of the student to determine what she works on or how she works on it fits quite well into the rationalist model of the school–as–factory and the technologists goal of maximizing "instructional delivery."

Such systems were an easy sell. They complemented existing organizational and practice models, and they signalled modernity and standardization (Newman, 1992). (Perversely, they were also claimed to promote individualization, since each student was tasked and speeded separately from the rest of the group. The fact she was working on exactly the same problems, with the same tools and in the same sequence as her classmates seems not to have mattered.) Since students work in isolation they accord well with the premise of structured competition. Since mastery at one level leads relentlessly to more difficult (but essentially identical) problems the students never have a chance to exhibit facility of a type that would threaten their teacher, and since the terminals at which they work are both limited in their

capacities and centrally controlled students have no opportunity to acquire a disruptive mastery of the technology itself.

Labs like these are prime examples of the non–neutrality of technology. They do not foster all or even several types of learning but rather one particular, and particularly narrow, conception whose origin is not with teachers who work with children but with the technologists, industrialists, and military designers who develop "man–machine systems" (Noble, 1991). They do not encourage or even permit many types of classroom organization but only one. They instantiate and enforce only one model of organization, of pedagogy, of relationship between people and machines. They are biased, and their easy acceptance into schools is indicative of the extent to which that bias is shared by those who work there.

The technology I have been describing is not the technology of computers, or computers–in–schools per se, anymore than armored cars represent the technology of internal combustion or washing machines the technology of electromagnetic induction. They are machines, to be sure, but machines require a social organization to become technologies. Thus the uses of computers described above for data–processing and "learning labs" are not examples of computer technologies but of normative, administrative, and pedagogical technologies supported by computers.

This distinction is important because many teachers, lay people, and some administrators have concluded from their experiences with such systems that computers in school are anathema to their notions of what schools ought to do with and for children. Computer–based technologies of the kind described above are hardly "neutral." Indeed, they are intensely normative and send unambiguous signals about what school is for and what qualities teachers ought to emulate and model. Interpersonal and social dynamics, serendipity, cognitive apprenticeship, and play all seem to be disdained by this instantiation of machine learning. The teacher's fear of "being replaced by a computer" is a complex anxiety. It obviously has a large component of institutional self–interest, since no–one wants to lose their job. But the notion that it would be possible to be replaced by a machine cuts deeper, to the heart of teachers' identity and self–respect. There has evolved among teachers an insular culture of self–congratulation that attempts to reassure them that they are competent and selfless professionals, that their social and institutional function is to develop the very best qualities in the children they serve. The suggestion that the deskilled tasks that teachers are called upon to perform might be better performed by machines calls this self–image into question in a manner that is painfully direct. It is hence unwelcome.

Beyond the question of self–respect but intertwined with it is the frustration that many teachers experience with the promulgation of a purely rationalist notion of education. Teachers, after all, are witness and partner to human development in a richer and more complex sense than educational technologists will ever be. Schools are where children grow up. They spend more waking hours in school with their teachers than they do at home with their parents. The violence that technologists do to our only public children's space by reducing it to an "instructional delivery vehicle" is enormous, and teachers know that. To abstract a narrow and impoverished concept of human sentience from the industrial laboratory and then inflict it on children for the sake of "efficiency" is a gratuitous, stunting stupidity and teachers know that, too. Many simply prefer not to collaborate with a process they experience as fundamentally disrespectful to kids and teachers alike.

Finally, there is the issue of the reshaping and redefining of teaching practice to suit the needs of technology. Cuban and Cohen maintain that technologies that are not sufficiently flexible to suit the existing strictures of classroom practice have little chance of significant implementation (Cohen, 1987; Cuban, 1986). While this may be true for "instructional delivery vehicles" like educational films or television, it doesn't hold for the myriad other educational technologies whose domain and deployment are not circumscribed by an individual classroom. The most obvious example is standardized testing. There is an extensive body of literature which shows that this technology, seldom supported and often resisted by teachers, has nevertheless had profound consequences on their classroom practice (Shepard & Dougherty, 1991; Shepard, 1991). Teachers have significantly reoriented the content and method of their instruction to facilitate capture by these instruments. Despite the absence of formal institutional sanctions, teachers have succumbed to strong pressure from their administrations for students to perform well on these tests, and have restructured their practice accordingly. The dictum that, "when the classroom door closes teachers can do what they like," doesn't apply when crucial technologies of assessment reside outside the classroom (See Note 4). Teachers are hence understandably concerned that the introduction of computers in the form of a technology with its own built–in assessment capabilities will not function to provide them with another tool they can use or not as they wish, but rather that it might force them to tailor the content and style of their teaching to suit the technology.

CULTURAL CHANGE

In this essay I've painted a rather depressing picture of schools as grim, self–perpetuating systems of repressive mediocrity for their employees and their students. I've described how technologies are variously embraced and resisted in the effort to perpetuate this system and maintain the organizational status quo. I've tried to make clear that since schools are complex organizations not all their component members or constituencies have identical interests at all times; that a technology that is favorable to one faction at a given moment may be resisted by another which might favor it for different reasons under different circumstances. Most importantly, I've tried to show that technologies are neither value–free nor constituted simply by machines or processes themselves. Rather, they are the uses of machines in support of highly normative, value–laden institutional and social systems.

I don't believe that decisions to deploy or not deploy a given technology are made with diabolic or conspiratorial intent. I don't believe that teachers and administrators consciously plot to consolidate their hegemony. Rather, I believe that the mental model under which they operate forecloses some options even before they can be formally considered, while making others seem natural, neutral, and, most dangerously, value–free. It is those latter options, those 'easy' technologies that are adopted and implemented in schools. If one accepts this framework, there are only two ways to imagine a relationship between an introduction of technology into schools and a substantive change in what schools do and how they do it. The first is to believe that some technologies can function as Trojan Horses; that is, that they can engender practices which schools find desirable or acceptable but which nevertheless operationalize new underlying values which in turn bring about fundamental change in school structure and practice.

The second is to hope that schools will come to re–evaluate the social purposes they serve, the manner in which they serve them, or the principles of socially–developed cognition from which they operate. The impetus for this change may be internal, as teachers and administrators decide that their self–interest in serving new purposes is greater than their interest in perpetuating the existing scheme of things. It may be external, as powerful outside forces adjust the inputs available to and outputs desired from the schools. It may be institutional, as restructuring initiatives encourage schools to compete with one another in a newly–created educational marketplace.

To a certain extent all these processes are underway, albeit slowly, unevenly, and under contestation. On the Trojan Horse front, there are more and more reports of teachers taking physical and pedagogical control of computers from the labs and the technologists. They are being placed in classrooms and used as polymorphic resources, facilitators, and enablers of complex social learning activities (Newman, 1990, 1992; Kerr, 1991). As computers themselves grow farther from their origins as military–industrial technologies, educational technologists increasingly are people whose values are more child–centered than those of their predecessors. This is reflected in the software they create, the uses they imagine for technology, and their ideas about exploration and collaboration (Char & Newman, 1986; Wilson & Tally, 1991; Collins & Brown, 1986). If students, parents, and teachers are all pleased with the cognitive and affective changes induced locally by working with these types of tools (and it is by no means certain that they will be), it may become difficult to sustain the older, more repressive features of school organization of which centrally–administered and imposed technology is but one example.

The second possibility, that schools will re–evaluate their means and ends, also seems to have momentum behind it, at least within a somewhat circumscribed compass. Teachers and administrators are taking steps to secure the autonomy neccesary to re–engineer schools–as–technologies, though not all are happy with this unforeseen responsibility and some choose to abdicate it. Nevertheless, for the first time practitioners are being given the chance to re–design schools based on what they've learned from their experiences with children. Given that chance, many teachers and administrators are demonstrating that schools and school technology can support practices of the kind which reflect values described by Wendell Berry in another context as care, competence, and frugality in the uses of the world (Berry, 1970). This, in turn, precipitates a re–visioning of the purposes and organization of school technologies away from the top–down, centrally–administered, instantiations which have failed so remarkably in the past.

Most importantly, however, I believe that the dominant mechanical metaphor on which we model our institutions is changing. As we move from machine to information models we will inevitably require that our institutions reflect the increased fluidity, immanence, and ubiquity that such models presuppose (See Note 5). As we change our medieval conceptions of information from something that is stored in a fixed, canonical form in a repository designed exclusively for that purpose and whose transfer is a formal, specialized activity that takes place mainly within machines called schools, schools will change too. They will not, as some naively claim, become redundant or vestigial simply because their primacy as information–processing modelers is diminished (Perelman, 1992). Rather, they will continue to per-

form the same functions they always have: those relating to the reproduction of the values and processes of the society in which they're situated.

What this underlines, I think, is that machines can indeed change the culture of organizations, even ones as entrenched and recalcitrant as schools have proven to be. But they do it not, as technologists have generally imagined, by enabling schools to do the same job only better (more cheaply, more efficiently, more consistently, more equitably) but by causing them to change their conception of both what it is they do and the world in which they do it. This shift is not instigated by the machines deployed within schools but by those outside of it, those that shape and organize the social, economic, and informative relationships in which schools are situated and which they perpetuate. This is not the same as saying that machines which are widely used outside the classroom will automatically diffuse osmotically into the classroom and be used there: history shows that this is clearly not the norm.

What is happening, simply put, is that the wide, wet world is rapidly changing the ways it organizes its work, its people, and its processes, reconceptualizing them around the metaphors and practices enabled and embodied by its new supreme machines, distributed microcomputer networks. Archaic organizations from the cia to ibm to the university have fundamentally rearranged themselves along the lines I've outlined in the notes to this report. Schools have been out of step with this change, and it is this misalignment more than anything else that causes us to say that schools are "failing" when in fact they are doing exactly the jobs they were set up and refined over generations to perform. It is the world around them that has changed, so much so that the jobs we asked them to carry out now seem ridiculous, now make us angry.

The fundamental instinct of durable organizations is to resist change: that is why they are durable. As schools scurry to serve the new bidding of the old masters, and as they induct younger workers raised and trained under the auspices of new models and new practices, we discover—not surprisingly—that schools too are reorienting themselves along the lines of the latest dominant machine and, consequently, welcome those machines inside to assist in their nascent realignment of means and ends.

The norms and procedures of entrenched bureaucratic organizations are strong and self–reinforcing. They attract people of like minds and repel or expel those who don't share them. Schools are technologies, machines with a purpose. They embed their norms and processes in their outputs, which in the case of schools helps them to further strengthen their cultural position and resist marginalization. But they can never be independent of the values of society at large: if those change, as I believe they are beginning to, then schools must too. If they do not, then they will be replaced, relegated to the parts–bin of history.

NOTES

1. This usage of the schools to promote an "outside" agenda once again invokes their role as a transmission technology even as it fails to take into account the schools' own values and culture. It shares the technologists' instrumentalism, albeit to different ends.

2. Although we may apotheosize this habit we didn't invent it. The desire to apprehend the complexity of the world, to encompass it in a more immediately accessible form,

gives Western culture a long, albeit narrow, history of mechanical and neo–mechanical metaphor. The shift from one metaphor to another generally lags technology itself by a generation or so, and each shift to a new metaphor drastically effects the way cultures view the natural and human worlds. Until the fourteenth century there were no such metaphors. Indeed, the rope of nearly all metaphor, metonymy, and analogy was tied to the natural or supernatural rather than to the created world, simply because there were no complex machines as we understand them today. The invention of the astrolabe, and its close and quick descendant, the clock, provided the first tangible human creation whose complexity was sufficient to embody the observed complexity of the natural world. It's at this time that we start seeing references to the intricate 'workings' of things and of their proper 'regulation,' usually of the cosmos and nature, although occasionally of human systems as well. The clock, with its numerous intricate, precise, and interlocking components, and felicitous ability to corporealize the abstraction of temporality, shaped western perceptions of the world by serving as its chief systemic metaphor for the next five hundred years. In the early nineteenth–century, the metaphor of the clock was gradually replaced by that of the engine, and somewhat more generally, by the notion of the machine as a phylum unto itself. The figures shift from those of intricacy and precision to those of 'drive' and 'power,' from regulation to motivation. In the early twentieth–century, as technology became more sophisticated, the concepts of motivation and regulation were to some extent merged in the figure of the self–regulating machine. This is essentially the dominant metaphor with which we've grown up, the notion of a 'system' which contains the means of both its own perpetuity and its own governance, and this metaphor has been applied to everything from political science, to nature, to the human body, to the human mind. The enginic 'drive' of the Freudian unconscious, Darwinian evolution, and the Marxian proletariat give way to 'family systems,' ecosystems, and political equilibria as the Industrial Revolution lurches to a close. The edges of a new metaphor for complex systems can be seen emerging, however, one which is able to embrace the relativity and immanence which stress mechanical metaphors to the point of fatigue: that of the computer and its data networks. We see, and will see more, large–scale shifts away from the concepts of drive and regulation to those of processing and transmission. The raw material upon which processes act will be regarded not as objects and forces but as data, which is not a thing but immanence itself, an arbitrary arrangement given temporary and virtual form. The action will be seen as a program, a set of instructions, allowing for more or fewer degrees of freedom. Interrelationships will be embodied in paths, arrangements, and pointers rather than linkages (creakingly mechanical) through which objects transmit force. Important phylogenic distinctions will be made between hardware (that which is fixed/infrastructure) and software (that which determines use and function). This has tremendous consequences for our notions of property, of originality and authorship, of privacy and relationship. It may, perhaps, be less limiting than the mechanical metaphors it will largely displace.

3. It is neither possible nor desirable to ignore the issue of gender here. It may be coincidence that the classroom, the one place where women have historically had a dominant institutional place, is repeatedly characterized by technologists as a place of darkness and chaos, stubbornly resistant to the enlightening gifts of rationalized technology. It may be coincidence that educational technologists are as a group overwhelmingly male but direct their ef-

forts at transformation not at the powerful (and overwhelmingly male) community of planners and administrators but at the formally powerless and (overwhelmingly female) community of practitioners. It may be coincidence that the terms used to describe the insufficiency of the classroom and to condescend to the folk–craft of teaching are the same terms used by an androgenized society to derogate women's values and women's work generally. But that's a lot of coincidence. Kerr discusses the differences in world–view and values between the teachers who deal with children and the technologists who approach the classroom from industrial and, as Noble demonstrates, often military backgrounds as well (Kerr, 1990; Noble, 1991). He stops short of characterizing what may perhaps be obvious but nevertheless should be acknowledged: the casual, pervasive, pathetic misogyny which characterizes the attitude of dominant culture towards any environment or activity that is predominantly female. It is perhaps for this reason that we never see proposals to replace (mostly male) administrators with machines. The usage of computers to perform administrative tasks should pose no more, and probably fewer, value dilemmas and conflicts than their usage to define and practice teaching.

4. The question of capture processes in education deserves more exploration than I can give it here. As put forth by Agre, "capture" describes the restructuring of workplace practices to facilitate the capture of information by a ubiquitous network technology. It contrasts with the surveillance model, which relies on visual metaphors, is surreptitious, and is centrally organized. Capture processes, on the other hand, don't watch what you do but continuously interact with it. They are about as far from surreptitious as you can get, since they involve the active reorganization of activities for the explicit purpose of gathering information. Rather than being centrally directed they are (re)enacted by individuals as they perform a socially–embedded set of tasks. Agre cites as examples Automatic Vehicle Identification for highway toll collection, and the organization of large restaurant chains where every action from the greeting of customers to the taking of orders to the preparation of food is designed around the needs of computerized information capture (Agre, 1993).

5. In the shift from a mechanical to a digital organization of society we can expect the following changes in the social construction of relationship: Information, not authority; networks and pointers, not linkages; inexpensive ubiquity, not dear scarcity; simultaneous possession, not mutually–exclusive ownership; instantaneity/timeshifting, not temporality; community of interests, not community of place; distributed horizontality not centralized verticality. I don't contend that we thereby usher in Utopia. These new structures will bring new strictures. But they will be very, very, different.

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